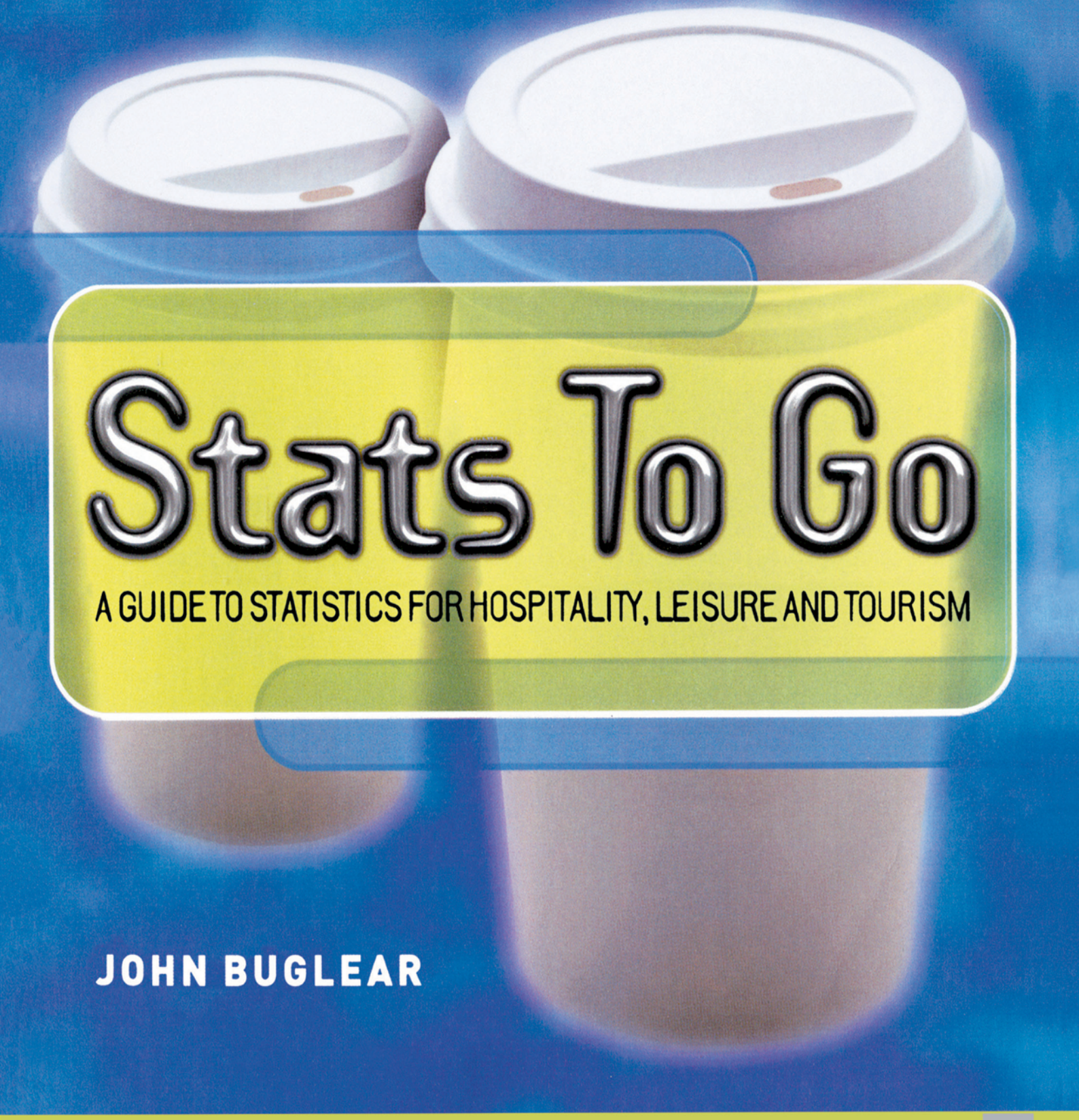
HOSPITALITY, LEISURE AND TOURISM



Stats To Go

A GUIDE TO STATISTICS FOR HOSPITALITY, LEISURE AND TOURISM

JOHN BUGLEAR

ROUTLEDGE

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A guide to statistics for hospitality, leisure and tourism

John Buglear

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Preface

This book is intended to equip students and others interested in the hospitality and tourism industries with an understanding of Statistics. As the sub-title implies, this is a guide to using Statistics rather than a specialist Statistics textbook. The book provides an accessible insight into the use of a variety of statistical techniques. These techniques are discussed and demonstrated using worked examples set in hospitality and tourism contexts.

The book aims to encourage readers to use computer software to carry out statistical work. It provides guidance on the use of MINITAB* and the statistical aspects of Excel. As a consequence the use of statistical tables has been kept to a minimum.

Solutions to review questions are included. These are intended to help students monitor their own progress and make the book an effective basis for independent learning.

*MINITAB is a registered trademark of Minitab Inc., 3081 Enterprise Drive, State College, PA 16801, USA. http://www.minitab.com

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CHAPTER 1

Starting out

Chapter Objectives

This chapter will help you:

- To understand why the ability to deal with numbers is important.
- To see how this book can help you develop that ability.
- To prepare effectively to study Statistics.

In this chapter you will find:

- A discussion of the importance of numbers to hospitality and tourism businesses.
- A description of the approach and style used in this book.
- An introduction to key words.
- Guidance on basic numerical skills you will need to use.
- Advice on technological support.

1.1 Numbers in the hospitality and tourism industries

This book is about analysing numbers. But why should analysing numbers matter to someone studying hospitality or tourism? How relevant can it be for someone planning to build a career in hospitality or tourism?

To understand this, and to appreciate why the study of numbers is built into your course, consider how the hospitality and tourism sector has changed in the course of a generation. The set of organizations that operate in the sector and the products they offer have changed dramatically.

If you look at films or read novels that reflect the lives people led twenty or thirty years ago, you will notice the changes. Almost all licensed premises were male-oriented places that provided a fairly narrow range of beverages and no hot food. At work people ate food chosen from a limited range of traditional fare in a workplace canteen. Fish and chips was the staple fast food and dining out was an infrequent pleasure for most people. For those who did dine out, the limits of exotic eating amounted to Chinese or Indian restaurants. Holidays were taken once a year, largely within the UK. Often families would return to the same resort, sometimes the very same place to stay, year after year. The fun-lovers could go to holiday camps, the very adventurous impressed their neighbours by going to Spain. Apart from the journeys of travelling salesmen, business travel hardly existed. People who made it to retirement age lived on modest pensions and travelled little, except to see relatives. For children there were beaches, parks and funfairs.

How strange all that seems, how very different things are today. We have a wide variety of licensed premises where managers and owners try to create an ambience and offer food and beverages to appeal to target market segments. The workplace canteen with its own kitchens has all but disappeared, instead contractors deliver a wide range of sandwiches and cook-chill food to work-based outlets. The phrase 'fast food', unknown a generation ago has become very big business, compared to which the traditional fish and chip shop seems like a cottage industry. The centre of even a modest-sized town provides a cosmopolitan selection of restaurants. The cuisine of Thailand, Mexico, Italy, the USA and Japan is usually only a short distance away. The popularity of food from exotic places of course reflects the transformation in the holiday market. A long-haul holiday is likely to be one of several holidays taken during a year. A shopping weekend in New York is no longer purely a bizarre indulgence of the super-rich. Business travel has become a major market with specialist operators. Retired people are often the most avid travellers, transforming the off-season business for many resorts. As far as

children are concerned, the emergence of the theme park and the all-weather activity centre means that holiday decisions for many families are more overtly child-driven.

These are fundamental and far-reaching changes. Experts may disagree about the factors that have caused them, but as a result of them the business environment faced by hospitality and tourism organizations has altered profoundly, and will almost certainly continue to do so.

A further source of uncertainty for the hospitality and tourism sector is the fact that its products are typically considered luxury goods and services that are purchased from discretionary income. Demand for them is therefore highly sensitive to consumer confidence and taste. A family facing the loss of an income may well halve its consumption of clothing but is likely to abandon the idea of going on holiday completely.

How do organizations cope with this degree of change? The answer, in some cases, is that they don't. Many of the companies that dominated the sector a generation ago no longer exist. They became history because they failed to respond to the changing market. Others survived and some small operations thrived, becoming market-leaders within the lifetimes of their founders.

Although luck and the good fortune of happening to be in the right market place with the right product may have played a part, to succeed in a changing environment an organization needs to recognize the changes and anticipate the consequences for its operations. How can it do that? By constantly studying its markets and monitoring its operations. This means counting and measuring key factors, in other words gathering numerical facts, or statistics.

In every organization there is a flow of numbers which are either deliberately collected or arise from the regular interactions with customers, suppliers and other significant organizations. These figures in themselves cannot tell the organization what is going on in the market or how it is performing. One of the responsibilities of management is to ensure that such figures are used, which means they have to be processed and analysed. The patterns that emerge from this analysis provide information that enables managers to understand the situation they face and base their decisions on that understanding.

The ability to analyse figures and interpret the results is therefore considered a key management skill. Look at recruitment advertisements for management posts and you will see that employers attach great importance to 'numerical skills' and 'problem-solving'.

If you want to build a successful management career these are skills that you have to acquire sooner or later. Your course will provide you with the opportunity of developing them. Make the most of that opportunity and you will have a cutting-edge skill that will pay dividends for you in the future.

1.2 How this book is organized

This book will help you deal with the numerical parts of your course. How you use it depends on how you approach the study of numbers you are about to start. It can be a crutch to help you limp through what may seem like an unwelcome revisit to the sums of schooldays, or it can be a springboard that will help you accumulate a key investment for your future – the skill of numeracy.

This book may influence your attitude to studying numbers, but it cannot decide it. The attitude you take is something for you to develop, but whether this book is to be a crutch or a springboard for you, it is intended to be a guide which will provide support for the numerical work you will undertake throughout your course.

The first five chapters of the book (including this one) deal with topics that you are likely to meet during the first stage of your course. They deal largely with *descriptive* techniques, that is methods that will enable you to arrange or analyse data in a way that helps *describe* the situation being studied.

Chapters 6–9 cover topics that you may meet at a later stage of your course. They deal with *inferential* techniques, that is methods that enable you to make *inferences* or draw conclusions about an issue in general based on the study of a comparatively modest amount of data.

The final chapter is designed to help you tackle numerical aspects of the final-year project or dissertation you will probably be asked to write.

The book will introduce you to a variety of analytical techniques that together constitute a 'tool-kit' of methods that can be used to investigate situations and help solve problems. Like any other tool-kit, the key to using it properly is to know not only what each tool does, but to know how and when to use it. The book will help you develop this ability by illustrating the application of the methods described using contexts taken from the hospitality and tourism sectors.

Each technique will be explained and demonstrated. Any calculations will be explained in words before symbols are used to represent the process.

Being able to apply a technique, to produce the correct result from a calculation, is important, especially if you find 'learning by doing' useful, but it is by no means the end of the story. It is even more important to be able to interpret the results that the technique has enabled you to produce and to communicate the meaning of those results. In your future career you may be asked to apply techniques of analysis but you are much more likely to need to be able to explain results, perhaps to judge whether appropriate techniques have been used to produce them. The book therefore provides you with not only a description of each

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technique and an illustration of its use, but also a discussion of the types of results you could get, and what each of them would mean.

At the end of Chapters 1–9 there are a set of review questions that you can use to confirm your understanding of the methods and ideas featured in each chapter. You can find answers to these questions at the back of the book.

1.3 Taking the first steps

There are two key preliminary tasks that are worth investing a little time and effort on getting to grips with from the very beginning. The first is to understand a few key words which may be completely new to you, or whose meanings in the context of this subject are unfamiliar to you. The second is to review a set of basic arithmetical operations, which are involved in the use of some of the methods demonstrated further on in the book. Being clear about these basics from the start will mean you avoid unnecessary confusion later on.

You will find that the terms explained below are used many times in this book. They are the first words in a technical vocabulary that will become familiar to you as you proceed. As you will find with other subjects you study or interests that you have outside college, there are specialist words and phrases to comprehend, but once you have grasped their meaning you will get used to using them as a matter of course.

1.3.1 The key words you need to know

- *Data* A plural noun (the singular form is *datum*) which means a set of known or given things, facts. Note that data can be numerical (e.g. age of people) or non-numerical (e.g. gender of people).
- *statistics* Without a capital letter, i.e. in its lower case form, this means a set of numerical data or figures that have been collected systematically.
- *Statistics* With a capital letter this is a proper noun that means the study of statistics, the set of methods and theories that can be used to arrange, analyse and interpret numerical data.
- *A variable* A quantity that varies, the opposite of a constant. For example the number of rooms sold in a hotel is a variable, whereas the number of hours in a day is a constant. In the expressions that we will use to summarize methods a capital letter, usually X or Y, will be used to represent a variable.
- *Value* A specific amount that it is possible for a variable to be. For example the number of rooms sold in a 100-bedroom hotel

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could be 53 or 68 or 93. These are all possible values of the variable 'number of rooms sold'.

- *Observation* or *observed value* A value of a variable that has actually occurred, i.e. been counted or measured. For example if hotel staff sell 75 rooms for a particular night that is an observation or observed value of the variable 'number of rooms sold'.

  An observation is represented by the lower case of the letter used to represent the variable; for instance 'x' represents a single observed value of the variable 'X'. A small numerical suffix is added to distinguish particular observations in a set; x_1 would represent the first observed value, x_2 the second and so on.

- *Random* This adjective refers to something that occurs in an unplanned way. A *random* variable is a variable whose observed values arise by chance. The sales of bottled beer in a pub are a variable which is random, whereas the number of days in a month is a variable which is not random, i.e. its observed values are pre-determined.

- *Distribution* The pattern exhibited by the observed values of a variable when they are arranged in order of magnitude. A *theoretical* distribution is one that has been deduced, rather than compiled from observed values.

- *Population* Generally this means the total number of persons residing in a defined area at a given time. In Statistics a *population* is the complete set of things we want to investigate. These may be human such as all the people who have visited a theme park, or inanimate such as the flights made by an aircraft.

- *Sample* A subset of the population, that is a smaller number of items picked from the population. A *random sample* is a sample whose components have been chosen in a random way, that is on the basis that any single item in the population has no more or less chance than any other to be included in the sample.

1.3.2 The basic numerical skills you need

Addition and subtraction

Addition, represented by the plus sign '+', is the process of putting two or more numbers together to make a sum or total. As long as the numbers being added together are positive, i.e. more than zero, the resulting total grows as more numbers are added.

Example 1.3

A member of staff at a 'drive-through' conducts four operations in the course of serving a customer. If these tasks take 10, 12, 7 and 8 seconds, what is the total time that will elapse between the time a customer arrives at the order point and the time they can depart from the service point?

You can get the answer by adding together the times taken for the four operations.

Total time = 10 + 12 + 7 + 8 = 37 seconds

Because Statistics often involves combining observations, the arithmetical process of addition is a process you will come across in the context of several techniques dealt with later in the book.

Although you are probably already familiar with addition, you may not have encountered the symbol called 'sigma', which is used in Statistics to represent it. Sigma is the capital letter S from the Greek alphabet, written as 'Σ'. It is the letter s because s is the first letter of the word 'sum'. It is a Greek letter because at the time that much of the theory that makes up the subject of Statistics as we know it today was developed, the so-called 'classical' languages of the ancient world were taught in the schools and universities. The Greek language, with its particular alphabet, therefore provided the pioneers of Statistics, and other fledgling disciplines, with a ready source of distinctive symbols.

The symbol Σ (sigma) stands for 'the sum of' when it is used in Statistical expressions, for example:

Σx means 'the sum of a set of observed values of the variable X'

Sometimes it is necessary to specify precisely which observed values of X are to be added together. To show this, the letter '*i*' is used to count the observations, for example:

$\sum_{i=1}^{4} x$ means 'the sum of the first to the fourth observations of the variable X'

The expression '$i = 1$' below the sigma tells us to start the addition with the first observed value of x and the '4' above the sigma sign tells us to finish the addition with the fourth observed value.

Example 1.2

In the situation described in Example 1.1, we could show that the total time taken to serve a customer in the drive-through facility (which we could represent by 'T') is the sum of the time taken to perform four tasks by using the expression:

$$T = \sum_{i=1}^{4} t = t_1 + t_2 + t_3 + t_4 = 10 + 12 + 7 + 8 = 37$$

If it is necessary to indicate that all of a set of observations should be added together and the exact number of observations is not known, we use the letter 'n' to represent the last observation in the set, so:

$\sum_{i=1}^{n} x$ means 'the sum of the first to the last observations of the variable X'

As you proceed with your study of the subject, you will find that the letter 'n' is used throughout Statistics to represent the number of observations in a set.

At first these types of symbol may appear strange to you, but it is worth learning to recognize and use them, they can become very useful shorthand forms which will save you space and time in future work.

Subtraction, represented by the minus sign '–', is the process of subtracting or 'taking away' one or more numbers from another. As long as the numbers being subtracted are positive, i.e. more than zero, the result reduces as more numbers are subtracted.

Example 1.3

The gross weekly pay of a tour guide is £200. If her stoppages are £28 tax, £9 National Insurance, and £52 accommodation charge, what is her weekly take-home pay?

You can get the answer by subtracting the stoppages from the gross wage.

Take-home pay = £200 – £28 – £9 – £52 = £111

An alternative approach to this operation is to add the stoppages first and then subtract the total stoppages from the gross pay. This would be represented in the following way:

Take home pay = £200 – (£28 + £9 + £52) = £111

The round brackets dictate that the operation shown within them must be carried out first. They are used to indicate priority.

You may well find addition and subtraction fairly easy, but there are cases where they are not so straightforward; first, when negative numbers are involved, and second when the operation involves numbers measured in awkward units, e.g. minutes and hours.

Addition and subtraction may give you some difficulty if negative numbers are involved. If a negative number is added to a total, it reduces the total.

Example 1.4

A customer's hotel bill consists of the following items: a room charge of £60, £25 for an evening meal, £8 for Minibar items, and a £10 discount for using a promotional voucher. What is the total amount that should be on the bill?

The answer can be shown as:

Total amount = £60 + £25 + £8 + (–£10) = £83

You can see that round brackets have been used, both to highlight the fact that there is a negative number in the sequence and to indicate that it must be dealt with first. This means deciding how to tackle the apparently contradictory '+ –' sequence of symbols. In fact the minus sign overrides the plus sign, so adding a number is therefore the same as subtracting a number. The arithmetical expression used to find the total amount in Example 1.4 has exactly the same result as the following expression, which combines addition and subtraction:

Total amount = £60 + £25 + £8 – £10 = £83

But what do you do if you have to subtract a negative number? In fact subtracting a negative number produces the same result as adding a positive number.

Example 1.5

The sharp-eyed Front Office Manager in the hotel mentioned in Example 1.4 spots that the voucher is out of date. What effect will this have on the total amount of the bill?

They would have to take away the reduction from the previous total, so now:

Total amount = £83 – (–£10) = £93

You get exactly the same result if you simply add the amount concerned, £10.

You may find it helpful to imagine the two minus signs 'cancelling each other out' to leave you with an addition. Alternatively it may help to think that taking away a negative is always positive.

Addition and subtraction involving time is something many people find difficult because time is measured in hours made up of 60 minutes, and minutes made up of 60 seconds, rather than nice, neat numerical parcels of ten. The use of the 24-hour clock on top of all this seems to phase most people completely.

Example 1.6

A business traveller drives for 12 minutes to reach her local railway station where she boards a train that takes 33 minutes to reach its London terminus. It takes her 24 minutes by tube to reach another London terminus, where she boards another train. After a journey that takes 1 hour 5 minutes to reaches her station, from where she takes a 10-minute taxi ride to her destination. What is the total journey time?

To get the answer we can express all the times mentioned, including the figure for the second train journey, in minutes.

Total journey time = 12 + 33 + 24 + 65 + 10 = 144

The answer may not be satisfactory in this form. To convert it into hours and minutes we need to find how many units of 60 minutes there are in 144 minutes. The answer is 2, so the total journey time is 2 hours (120 of the total number of minutes) and 24 minutes (the number of minutes left over when 120 is subtracted from 144).

Example 1

If the traveller described in Example 1.6 begins her journey at 11 am in the morning, what time will she arrive at her destination, and how would this time be expressed using the 24-hour clock?

To get the answer, work in hours first, then minutes.

Arrival time = 11 + 2 hours = 1pm

+ 24 minutes = 1.24pm

To express this using the 24-hour clock, add 12 to the number of hours, because the arrival time is after midday.

Arrival time = 1.24 + 12 = 13.24

But what if the traveller started her journey later than expected, at 11.45, what time would she arrive? This is a little more complicated because the departure time and total journey time are measured in both hours and minutes. To find the answer we can start by adding the hours:

11 + 2 = 13

then add the minutes together:

45 + 24 = 69

Since this amount of minutes is longer than an hour, we have to express it in hour and minutes, and add the result to the sum of the hours:

69 minutes = 1 hour and 9 minutes

13 + 1 = 14 hours

+ 9 minutes = 14.09, or 2.09 pm

Multiplication and division

Multiplication, or 'times-ing', represented either by the 'times' sign '×' or the asterisk '*', is the process of multiplying two or more numbers together to make a product. If the number is multiplied by a number greater than one, the resulting product will be greater than the original number.

Example 1.8

A holidaymaker wishes to convert £240 into US dollars. If the rate advertised at the bureau de change is $1.60 to the pound, how many dollars will his pounds buy?

You can get the answer by multiplying the total number of pounds by the exchange rate.

Dollars he can buy = £240 × 1.60 = $384

In this case the number of dollars is greater than the number of pounds, the product represents a numerical increase. But if you multiply a number by another number that is less than one, you will get a product that is lower than your first number.

Example 1.9

A business traveller returning from Oslo has 3200 Norwegian krone that she wishes to change into pounds. If the rate available at a bureau de change is £0.08 per krone, how many pounds will she get for her krone?

To get the answer, multiply the total number of krone by the exchange rate.

Pounds she can buy = Kr3200 × 0.08 = £256

If you have to multiply a positive number by a negative number, the product will be negative. However if you multiply two negative number together, the product will be positive:

$3 \times (-2) = -6$ but $(-3) \times (-2) = 6$

Division, or finding how many times one amount 'goes into' another, is the process of dividing one number by another. It is represented either by the forward slash '/' or the sign '÷'. If you divide a number by another number that is greater than one, the result will be smaller than the original number.

Example 1.10

The 48 guests attending a function are to be offered a glass of wine on arrival. If the contents of one bottle of wine will fill three and a half glasses, how many bottles will be required?

We can obtain the answer by dividing the number of guests by the number of glassfuls per bottle.

Number of bottles = 48/3.5 = 13.714 (to 3 decimal places)

Something to note in Example 1.10 is that although we can get a very precise result, in this case specified to three places of numbers after the decimal point, in the situation described the figure would be rounded up to the nearest whole number, 14.

If you divide a number by another number that is less than one, the result will be larger than the original number.

Example 1.11

A visitor to Britain sees a sign saying 'Airport 7 miles'. She asks you how far that is in kilometres.

A kilometre is equivalent to 0.62 of a mile (to 2 decimal places), so to reply to her question you need to find how many times 0.62 will 'go' into 7, that is you must divide 7 by 0.62.

Kilometres to the airport = 7/0.62 = 11.29 (to 2 decimal places)

Squaring and square rooting

Squaring, or taking the square of a number is the process of multiplying a number by itself. The process is represented by the number with a superscript showing the number two, for example the square of three, or three squared would be written 3^2 which tells us to multiply three by three.

If the number you want to square is more than one, the result will be larger than the number itself, for instance the square of three is nine. However if the number you want to square is less than one, the result will be smaller than the number itself, for example the square of a half is a quarter.

Example 1.12

The floor covering of the dance space in a live music venue has to be replaced. If the dance floor is 4.2 metres long by 4.2 metres wide, how much new floor covering will be needed?

To find an area multiply the length by the width. In this case because the area is a square, that is the length and width are the same, we need only take the square of 4.2.

Floor area = 4.2^2 = 17.64 square metres

Squaring a positive number will always give you a positive result. But because multiplying one negative number by another always gives you a positive product, squaring a negative number will always give you a positive result as well.

So: $3^2 = 9$ and $(-3)^2 = 9$

The fact that we always get a positive result when we square a negative number is worth remembering because it plays a vital role in several statistical techniques that you will meet.

Square rooting, or taking the square root of a number is the process of working out what number squared would produce a particular number. It is represented by the radical or 'tick' sign, $\surd$, so the square root of 9 would be shown as $\surd 9$. The result of $\surd 9$ is 3 because the number 3 multiplied by itself gives you 9.

Example 1.5

A new ornamental garden featuring a square lawn area is to be laid out at a conference centre. If there are 160 square metres of turf available, what will the dimensions of the lawn be?

You can find the answer by taking the square root of 160:

Lawn area = $\surd 160 = 12.65$ (to 2 decimal places)

The lawn would be 12.65 metres long by 12.65 metres wide.

Fractions, proportions and percentages

Fractions, proportions and percentages sound very different, but they are only different ways of doing the same thing; expressing a part of something in relation to the whole. If, for example, water constitutes 100 g of 500 g of ham, this could be explained as either:

water constitutes one-fifth of the weight of this product

Or water constitutes 0.2 of the weight of this product

Or water constitutes 20 per cent of the weight of this product

One-fifth is the fraction, 0.2 is the proportion, and 20 per cent is the percentage. They are different ways of saying the same thing because there are five-fifths in one, five lots of 0.2 in one, and five lots of 20 per cent in 100 per cent. You should bear in mind that each of them is a number less than one, including the percentage, which doesn't look as if it is less than one.

It is easier to use percentages if you understand that the literal meaning of 'per cent' is per hundred. (The word 'cent' originally meant one hundred; a Roman centurion was an officer in the Roman army in charge of one hundred men.) This will especially help when you have to perform arithmetical operations using percentages.

Example 1.14

The proprietor of a souvenir shop located in the old part of a famous European city makes a deal with a tour guide. In return for the tour guide escorting parties of tourists to the shop the proprietor will give the tour guide 40 per cent of the profit the shop makes from the money the tourists spend. If the profit margin on the souvenirs is 60 per cent and the first group of tourists spends £735, how much money will the tour guide get?

The shop receives a profit of 60 per cent of £735, and the tour guide should receive 40 per cent of the 60 per cent of £735, so:

$$\text{Guide's share} = 40/100 \times 60/100 \times £735 = £176.40$$

Notice that in Example 1.14 the percentages appear in the expression as amounts per hundred.

Rounding and approximation * * *

You may find it easy to manipulate figures in your head, or you may find such a skill impossible and marvel at those who possess it. The truth is that anyone can learn how to carry out mental arithmetic, the tricks are to round the numbers involved so that they are easier to deal with, and to use approximation to get a ballpark result which can be refined with a little more effort.

People who find it easy to work out numerical problems in their head often use rounding and approximation intuitively, that is without thinking about it. In fact you may already round certain numbers as a matter of course. If someone asks how old you are, you would say '18' or '21' as appropriate, you wouldn't say '18 years, 3 months and 10 days' or '21.63 years'. Automatically you round down to the nearest completed year of your age. If you want to check how much money you have you probably look at the notes and pound coins in your purse or pocket and make an approximation. Only if you are particularly concerned about how much there is, or have time on your hands, are you likely to count every penny.

Rounding and approximation are therefore not entirely new concepts to you. If you can apply them systematically in your numerical work you will develop a skill which will give you a better 'feel' for numbers, enable you to spot mistakes and think numerically 'on your feet'.

Example 1.15

You walk into a fast food restaurant which is so empty that there is a member of staff waiting to take your order. You know what you want but you don't know how much it will cost. As you give your order your eyes take in the prices of the items you want: one burger £1.49, another burger £1.69, one portion of fries 89p, one cold drink 79p, one hot drink 59p. You want to work out roughly how much it will be so you can decide whether to count up your change or get out a note.

If you want a really quick answer, round up each item to the nearest pound.

Approximate total cost = £2 + £2 + £1 + £1 + £1 = £7

Because we have rounded every figure up, this result will be an overestimate, so we can be certain that the total cost will be no more than this, but it is a rather crude estimate. You could get a more accurate approximation if you rounded each figure to the nearest ten pence.

Approximate total cost = £1.50 + £1.70 + £0.90 + £0.80 + £0.60 = £5.50

Each of the five figures used here is rounded up by one penny, so you can get the exact total by taking five pence away from £5.50, which comes to £5.45.

1.4 Technological support

Although the subject of Statistics is about numbers, the amount of time you will spend actually performing calculations during your study of the subject can be minimized by using readily available technology, specifically a suitable calculator and appropriate computer software.

If you do not already have a calculator you really need to get one. It is an essential tool for the numerical aspects of your course, and probably some of the not so numerical parts of it as well. To be of use to you in statistical work the calculator you have must have a square root function, and it really is worth spending a little more money to get one with statistical functions. Sometimes such calculators are described as having a 'statistical mode' or an 'SD' (standard deviation) mode. Whatever it is called by the manufacturer, if you have a calculator that can perform statistical operations it will assist you immensely.

When you have your calculator the first thing that you should do is to make sure you don't lose the instructions. Your calculator is a sophisticated scientific instrument that can do much more for you than you might imagine, but you can only find out how if you have the instructions. As a safeguard it is a good idea to keep a photocopy of them in a safe place.

You will most likely have access to a computer, perhaps at home but almost certainly at your place of study. Because today computers are used so widely to send messages and to access internet facilities, it is easy to forget that computers were originally developed as machines to process data.

The computers we have today still possess that capability. With the right software the machine you use should become an invaluable aid to you in carrying out statistical work. It will do most of the laborious calculations for you, leaving you free to concentrate on learning how to understand and interpret the results.

This reflects how you are likely to be involved in using Statistics later in your career; it is your perception and interpretation of results that will be important, rather than whether you can compete with a computer to do the calculations. Of course it is important to be able to understand how the computer has arrived at the results, but let the machine do the hard work for you.

So, what is the right software? There are two types of software that can help you with statistical tasks: statistical packages and spreadsheet packages.

Statistical packages such as MINITAB (which has been used to produce the diagrams and results for this book), Splus, and SPSS offer a full range of statistical functions and can carry out just about all of the techniques you are likely to meet during your studies. The authors of packages of this type are usually qualified in Statistics.

Spreadsheet packages such as Excel are intended primarily for accounting work and offer a more limited range of statistical functions, but nonetheless can perform the majority of methods you will probably need to use.

Although these two types of package offer different ranges of functions and different styles of output, they have become increasingly similar in some respects. The data storage layouts in statistical packages have become more like spreadsheets; numbers are usually stored in the rows and columns of a 'spreadsheet' in Excel, and in the rows and columns of a 'worksheet' in MINITAB. The statistical output generated by spreadsheet packages looks more like that produced using a statistical package.

Example 1.16

What are the relevant commands to use in a spreadsheet package and/or a statistical package to store the costs of the items listed in Example 1.15, and to produce the total cost of the order?

Using Excel:

- Enter the first value in Cell A1 then press **Enter**.
- Enter the next value in Cell A2, press **Enter**, and repeat until all the values are stored in Cells A1 to A5 and the cursor is resting in Cell A6.
- Click on the **Autosum** button (labelled Σ) that is located amongst the toolbars at the top of the screen. The message '=SUM(A1:A5)' will appear in Cell A6.
- Press the **Enter** key. The figure that now appears in Cell A6 should be 5.45, the total cost of the items.

Using MINITAB:

- Enter the first value in Row 1 of Column 1 (C1) of the worksheet that occupies the lower half of the screen, and then press **Enter**.
- Enter the next value in Row 2 of C1, press **Enter**, and repeat until all the values are stored in Rows 1 to 5 of C1.
- Click on the Calc (Calculations) menu at the top of the screen.
- Click on **Column Statistics** in the **Calc** pull-down menu.
- In the Command Window that appears select Sum, click on the box beside **Input variable**, type C1 in the box and click the **OK** button. A message telling you that the sum of C1 is 5.45 appears in the session window that occupies the upper half of the screen.

If you have a choice, learn how to use the statistical package at your disposal. If you have time, learn to use both the statistical package and the statistical functions of the spreadsheet package. After all, in the course of your career the software you use will evolve and you will need to adapt to it, so why not get used to learning how to use a variety of software while you are studying?

If you have to choose between a spreadsheet and a statistical package, it may help to consider some of the pros and cons of each.

The advantages of a spreadsheet are:

- They are fairly straightforward to use.
- Basic calculations and diagrams can be produced quickly and easily.
- They are useful for more than statistical work, e.g. for accounting or manpower planning.

The disadvantages of a spreadsheet are:

- They can perform only a limited range of statistical tasks.
- The control you have over the composition of some output, particularly diagrams, is limited and tricky to manage.

The advantages of a dedicated statistical package are:

- They can carry out a comprehensive range of statistical operations.
- The methods they use and the output they produce are statistically meticulous.

The disadvantages of a dedicated statistical package are:

- They can be more difficult to learn to use.
- Transferring output into other software may be elaborate.

Because computer software is continually being upgraded and improved the disadvantages are being reduced and the advantages extended so check the latest available versions before making your decision.

Whatever package you use for your statistical work, don't expect to know how to use all its functions straight away. It is worth investing some time in learning how to get the best out of the software you use.

Any package should have a help facility, use it to search for advice. It is really an on-line user manual available at your fingertips! You will find that what you regard as awesome when you begin will very soon become familiar.

Review questions

1.1 Select which of the definitions listed below on the right match the words listed on the left:

(a) statistics	(i) something that occurs by chance
(b) Statistics	(ii) a subset of a population
(c) random	(iii) a complete set of things to study
(d) sample	(iv) a value of a variable that has occurred
(e) population	(v) a set of numerical data
(f) observation	(vi) the study of statistics

1.2 Match each of the symbols on the left to the definitions listed on the right:

(a) X	(i) the number of observed values
(b) Σ	(ii) the third in a set of observed values of the variable X
(c) x	(iii) a variable

(d) n (iv) a single observed value of the variable X
(e) x_3 (v) the sum of

1.3 A till-roll from a cash register in a café-bar shows the following transactions:

Beverages	£4.85
Food	£2.65
Food	£8.54
Food	£7.20
Beverages	£2.36

If the variable X is defined as the money taken per transaction:

(a) Calculate $\sum_{i=1}^{n} x_i$, the total amount taken through the till.

(b) Calculate $\sum_{i=2}^{4} x_i$, and explain what the answer means.

1.4 You have to fly from London to Tashkent. The plane is due to depart at 21.30 and the airline insists that you check in two hours before take off. You estimate that it will take an hour and a half to drive to the airport and a further 20 minutes to make your way from the car park to the check-in desk.

(a) What time should you start your journey to the airport?
(b) The flight is scheduled to take 6 hours 45 minutes. Going through passport control and collecting your baggage should take an hour. If local time is five hours ahead of UK time, by what time should the person who is meeting you aim to be at the airport in Tashkent?

1.5 A tour operator is organizing a coach trip around Bavaria. She has two vehicles available in Munich that could be used. In most respects the vehicles are identical, so she will use the one that has the better fuel economy. According to the records the first vehicle, which has been used extensively in the UK, does 15 miles per gallon. The second one, used entirely within Germany has a recorded fuel efficiency figure of 20 litres of fuel per 100 kilometres travelled. Which coach should she use? (There are 4.546 litres in a gallon and 1.609 kilometres in a mile, to 3 decimal places.)

1.6 A pub manager wants to create a square paved area immediately outside the main bar of the pub. A builder offers him 175 one metre square paving slabs that were left over from another job, at a very competitive price. What are the dimensions of the largest paved area that could be laid using these slabs, assuming that the pub manager does not want any slabs cut?